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↑ ABSTRACT

Previously, techniques such as class hierarchy analysis and profile-guided receiver-class prediction have been demonstrated to greatly improve the performance of applications written in pure object-oriented languages, but the degree to which these results are transferable to applications written in hybrid languages has been unclear. In part to answer this question, we have developed the Vortex compiler infrastructure, a language-independent optimizing compiler for object-oriented languages, with front-ends for Cecil, C++, Java, and Modula-3. In this paper, we describe the Vortex compiler's intermediate language, internal structure, and optimization suite, and then we report the results of experiments assessing the effectiveness of different combinations of optimizations on sizable applications across these four languages. We characterize the benchmark programs in terms of a collection of static and dynamic metrics, intended to quantify aspects of the "object-orientedness" of a program.

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↑ ABSTRACT

We describe the design and implementation of Dynamo, a software dynamic optimization system that is capable of transparently improving the performance of a native instruction stream as it executes on the processor. The input native instruction stream to Dynamo can be dynamically generated (by a JIT for example), or it can come from the execution of a statically compiled native binary. This paper evaluates the Dynamo system in the latter, more challenging situation, in order to emphasize the limits, rather than the potential, of the system. Our experiments demonstrate that even statically optimized native binaries can be accelerated by Dynamo, and often by a significant degree. For example, the average performance of -O optimized SpecInt95 benchmark binaries created by the HP product C compiler is improved to a level comparable to their -O4 optimized version running without Dynamo. Dynamo achieves this by focusing its efforts on optimization opportunities that tend to manifest only at runtime, and hence opportunities that might be difficult for a static compiler to exploit. Dynamo's operation is transparent in the sense that it does not depend on any user annotations or binary instrumentation, and does not require multiple runs, or any special compiler, operating system or hardware support. The Dynamo prototype presented here is a realistic implementation running on an HP PA-8000 workstation under the HPUX 10.20 operating system.

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↑ INDEX TERMS

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- ↪ D.3 PROGRAMMING LANGUAGES
- ↪ D.3.4 Processors
- ↪ Subjects: Optimization

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D. Software

- ↪ D.4 OPERATING SYSTEMS

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↑ ABSTRACT

Two promising optimization techniques for object-oriented languages are type feedback (profile-based receiver class prediction) and concrete type inference (static analysis). We directly compare the two techniques, evaluating their effectiveness on a suite of 23 SELF programs while keeping other factors constant. Our results show that both systems inline over 95% of all sends and deliver similar overall performance with one exception: SELF's automatic coercion of machine integers to arbitrary-precision integers upon overflow confounds type inference and slows down arithmetic-intensive benchmarks. We discuss several other issues which, given the comparable run-time performance, may influence the choice between type feedback and type inference.

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Primary Classification:

- K. Computing Milieux
 - ↪ K.6 MANAGEMENT OF COMPUTING AND INFORMATION SYSTEMS
 - ↪ K.6.2 Installation Management
 - ↪ Subjects: Benchmarks

Additional Classification:

- D. Software
 - ↪ D.3 PROGRAMMING LANGUAGES
 - ↪ D.3.2 Language Classifications
 - ↪ Subjects: Object-oriented languages
 - ↪ D.3.4 Processors
 - ↪ Subjects: Optimization

General Terms:

Design, Languages, Measurement, Performance, Theory

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↑ Peer to Peer - Readers of this Article have also read:

- Data structures for quadtree approximation and compression **Communications of the ACM** 28, 9 Hanan Samet
- A hierarchical single-key-lock access control using the Chinese remainder theorem **Proceedings of the 1992 ACM/SIGAPP Symposium on Applied computing** Kim S. Lee , Huizhu Lu , D. D. Fisher
- The GemStone object database management system **Communications of the ACM** 34, 10 Paul Butterworth , Allen Otis , Jacob Stein
- An intelligent component database for behavioral synthesis **Proceedings of the 27th ACM/IEEE conference on Design automation** Gwo-Dong Chen , Daniel D. Gajski
- Putting innovation to work: adoption strategies for multimedia communication systems **Communications of the ACM** 34, 12 Ellen Francik , Susan Ehrlich Rudman , Donna Cooper , Stephen Levine

↑ This Article has also been published in:

- Conference on Object Oriented Programming Systems Languages and Applications **Proceedings of the tenth annual conference on Object-oriented programming systems, languages, and applications** 1995 , Austin, Texas, United States

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